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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/762,097	01/20/2004	Berthold Hahn	5367-252PCON.	4556

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EXAMINER	
TRINH, MICHAEL MANH	
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)
	10/762,097	HAHN ET AL.
	Examiner	Art Unit
	Michael Trinh	2822

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *22 August 2007*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1,2,4-17 and 34* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1,2,4-17 and 34* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☐ Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date _____.

4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application

6) ☐ Other: _____.

DETAILED ACTION

*** This office action is in response to Applicant's Amendment and RCE filed August 22, 2007. Claims 1-2,4-17,34 are pending. Claims 18-33 were canceled by Applicant.

*** The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

Claim Rejections - 35 USC § 102

1. Claims 1,4-5 are rejected under 35 U.S.C. 102(b) as being anticipated by Kawaguchi et al (Article title "The formation of crystalline defects…", 1998, pp 24-26).

Re claim 1: Kawaguchi teaches (at pages 24-28) a method for forming a light-emitting device (page 24, last 7 lines) comprising at least the steps of: forming at least one compound semiconductor layer based on gallium nitride and being an active layer or a part of an active layer sequence of the light emitting device (page 24, last 7 lines, pages 25-27); and setting growth parameters used during production of the compound semiconductor layer such that, at least in some cases in a vicinity of dislocations in the compound semiconductor layer, regions are produced in the compound semiconductor having a lower thickness than remaining regions of the compound semiconductor layer (Fig 4, page 28), wherein, the regions with the lower thickness are formed to be less than half as thick as the remaining regions of the thin compound semiconductor layer of InGaN layer (as shown in Figures 4b,4a; page 28), since as shown in Figure 2b, at initial growth stage, the depth of the pits of about 30nm were formed in the initial InGaN layer of about 0.1μm (100nm) thickness, wherein by increasing thickness of the initial InGaN layer, the pits are 0.5μm up to the top of the pyramid (Figure 2c, last two lines of page 26). In forming a thin InGaN layer, Kawaguchi teaches (at Figs 4a,2b,1a; pages 25-28) growing an InGaN layer of about 0.1μm (100nm) in thickness, at the initial growth stage, wherein the InGaN initial layer includes a plurality of hexagonal small pits with the depth of about 30nm on average (thus, regions at bottom of the pits having a fixed thickness of about 100nm - 30nm = 70 nm). By further increasing the layer thickness, the area of facet in the pits becomes larger, wherein the thickness of the initial InGaN layer is increased by growing on the horizontal top surface of the initial InGaN layer (as shown in Figure 4a,2b) so that larger hexagonal pits are formed in the InGaN layer as shown in Figures 2c and 4b, wherein about "0.5μm up to the top

of the pyramid" is mentioned at last two lines of page 26 (the regions at bottom of the pits still remained having the same thickness of about 100nm - 30nm = 70 nm). As shown in Figure 4a, the initial regions of the InGaN layer at the pits are about a half as thick as the remaining regions of the thin compound semiconductor layer of InGaN layer at region (I). By increasing the thickness of the InGaN layer at the same region (I), by growing on the horizontal top surfaces, the initial regions InGaN layer at region (I) are formed with the lower thickness to be less than half as thick as the remaining regions of the thin compound semiconductor layer of InGaN layer at region (I), wherein the initial regions at bottom of the pits are still remained with about the same initial thickness. Re claim 4, wherein the compound semiconductor layer is formed from an $In_xAl_yGa_{1-x-y}N$ compound semiconductor, where $0 <= x <= 1$, $0 <= y<=1$ and $x+y <=1$ (page 24, last 7 lines; Abstract; page 25). Re claim 5, wherein AlGaN is provided when $x=0$ in the $In_xAl_yGa_{1-x-y}N$ (page 24, last 7, lines).

Claim Rejections - 35 USC § 103

2. Claims 2,6-12 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kawaguchi et al (Article title "The formation of crystalline defects...", 1998, pp 24-26) taken with Applicant's admitted prior art (present specification page 1-3).

Kawaguchi teaches (at pages 24-28) a method for forming a light-emitting device as applied to claims 1,4-5 above. Re claim 12, wherein the substrate includes sapphire (page 25, left column, lines 14-20).

Re claim 2, Kawaguchi teaches forming a light emitting device (LED), but lacks detailing about forming a first coating layer and second coating layer as in claim 2. Re claims 7-8, the first and second coating layer including $Ga_uAl_{1-u}N$. Re claim 9, MOCVD for depositing the coating layers. Re claim 10, including a buffer layer on the substrate. Re claim 11, the buffer layer include $Ga_mAl_{1-m}N$.

However, re claim 2, Applicant's admitted prior art teaches (at specification page 2, line 6 through page 3) forming a first coating layer formed from a compound semiconductor based on gallium nitride of a first conductivity type on the substrate; forming the compound

semiconductor layer, as a light-emitting layer, over the first coating layer; and forming a second coating layer formed from a compound semiconductor based on gallium nitride of a second conductivity type over the light-emitting layer, a composition of the compound semiconductor layer based on gallium nitride differing from a composition of the compound semiconductor of the first and second coating layers (present specification page 2, lines 6-26); wherein, re claims 7-8, the first and second coating layer include AlGaN layer (present specification page 2, lines 20-25); wherein, re claim 9, MOCVD is used for depositing the coating layers; and wherein, re claims 10-11, a buffer layer of GaN (m=1) is formed on the substrate, and wherein the first coating layer is formed on the buffer layer (present specification page 2, lines 20-25).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to form the light emitting device of Kawaguchi by forming a first coating layer and a second coating layers of AlGaN layer with a buffer layer on the substrate as taught by Applicant's admitted prior art. This is because of the desirability to form a high power structure blue and violet light emitting diode device.

Re claim 6, Kawaguchi does not detail about doping with foreign substance.

However, Applicants' admitted prior art also teaches (at present specification page 3, lines 22-25) doping the light-emitting layer with a p-type foreign substance and/or an n-type foreign substance to improve the luminance.

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to the light emitting device of Kawaguchi by doping the light-emitting layer with a p-type foreign substance and/or an n-type foreign substance as taught by Applicant's admitted prior art. This is because of the desirability to improve the luminance of the light emitting device.

3. Claims 13-17,34 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kawaguchi et al (Article title "The formation of crystalline defects…", 1998, pp 24-26) taken with Mukai (Article title "InGaN-Based Blue Light Emitting Diodes…" L839-841).

Kawaguchi teaches (at pages 24-28) a method for forming a light-emitting device as applied to claims 1,4-5 above, wherein re claim 34, wherein forming the at least one compound

semiconductor includes forming the active layer or a part of the active layer of the light emitting device (page 24, last 7 lines, pages 25,27).

Re claims 13-17, Kawaguchi teaches forming an active layer, but lacks mentioning, re claim 13, the active layer sequence with a quantum film structure, re claim 14, including at least one GaN quantum film; re claim 15, as an InGaN/GaN quantum film structure; re claim 16, with at least one undoped GaN quantum film; and re claim 17, with a GaN quantum film or with an intrinsic GaN quantum film.

However, Mukai teaches (at Figure 1; page L839) forming a light emitting diodes including an active layer sequence with a quantum film (single quantum well , SQW, re claim 13), wherein the quantum film includes at least one GaN quantum film (re claim 15), wherein the quantum film structure includes an InGaN/GaN (Figure 1; re claim 16); wherein the quantum film includes at least one undoped GaN quantum film (Figure 1, re claim 17); and wherein the quantum film includes a GaN quantum film as an intrinsic GaN quantum film (Figure 1, re claim 18).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to the light emitting device of Kawaguchi by forming the active layer sequence with the single quantum film as taught by Mukai above. This is because of the desirability to form a highly efficient blue/green InGaN singly quantum well structure light emitting diodes (LED).

4. Claims 1,4-5,13-17,34 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chen (Article of Pit formation in GaInN quantum wells, 9 February 1998) in view of Watanabe et al (6,555,846).

Chen teaches (at pages 710-712l; Figs 1-4) a method for forming a light-emitting device comprising at least the steps of: forming at least one compound semiconductor layer based on gallium nitride and being an active layer or a part of an active layer sequence of the light emitting device (page 710; Fig 1); and setting growth parameters used during production of the compound semiconductor layer such that, at least in some cases in a vicinity of dislocations in the compound semiconductor layer, a plurality of V-shape pits (pit density of about

$2.1x10^9/cm^2$) including regions are produced in the compound semiconductor layer in the V-shape pits having a lower thickness than remaining regions of the compound semiconductor layer (Figs 2d,2e,3,4, page 711), wherein the compound GaInN layer having a thickness of about 2 nm includes a plurality of the pits having average size of about 10 nm (or 25 nm) and also including the regions with the lower thickness to be less than as thick as the remaining regions of the thin compound semiconductor layer of InGaN layer (Figs 4,2d,2e,3; page 711). Re claim 4, wherein the compound semiconductor layer of GaInN is formed from an $In_xAl_yGa_{1-x-y}N$ compound semiconductor, where $0 <= x <= 1$, $0 = y$ and $x+y <=1$ (pages 710-711). Re claim 5, wherein AlGaN is mentioned at page 710 and Fig 1, as x=0. Re claim 13, forming an active layer sequence with a quantum film structure (Fig 1; page 710). Re claim 14, including at least one GaN quantum film (Fig 1). Re claim 15, including an InGaN/GaN quantum film structure (Fig 1). Re claim 16, with at least one undoped GaN quantum film (Fig 1; pages 710-712). Re claim 17, with a GaN quantum film as an intrinsic GaN quantum film (Fig 1, pages 710-711). Re claim 34, wherein forming the at least one compound semiconductor includes forming the active layer or a part of the active layer of the light emitting device (Fig 1; page 710).

Chen already teaches forming a plurality of pits in a vicinity of dislocations in the compound semiconductor layer of GaInN layer having regions having a lower thickness than the remaining regions of the compound semiconductor layer, but lacks to mention at least in some cases, regions are produced to be less than half as thick as the remaining portions of the compound semiconductor layer (as in claim 1).

However, Watanabe et al teach growing a compound semiconductor layer bases on gallium nitride, wherein a plurality of pits in a vicinity of dislocations in the compound semiconductor layer of GaInN layer are formed and having regions with a lower thickness than the remaining regions of the compound semiconductor layer, wherein at least in some cases, regions are produced to be less than half as thick as the remaining portions of the compound semiconductor layer 3(Figs 2,3; col 3, line 29 through col 6; col 5, lines 24-65), wherein, re further claims 4-5, wherein the compound semiconductor layer is formed from an $In_xAl_yGa_{1-x-y}N$ compound semiconductor, where $0 <= x <= 1$, $0 = y$ (col 2, lines 61-67).

The subject matter as a whole would have been obvious to one of ordinary skill in the art at the time the invention was made to form the light emitting device having a plurality of pits having regions in a vicinity of dislocations in the compound semiconductor layer having regions with a lower thickness than the remaining regions of the compound semiconductor layer of Chen to employ the teachings of Watanabe to make the light emitting device with the realization that, at least in some cases, the compound semiconductor layer having regions to be less than half as thick as the remaining portions of the compound semiconductor layer as taught by Watanabe. Re further claims 4-5, forming the compound semiconductor layer of InGaN or AlGaN by employing an $In_xAl_yGa_{1-x-y}N$ compound semiconductor, where $0 <= x <= 1$, $0 = y$ and $x+y <=1$ as taught by Chen and Watanabe would have been obvious to one of ordinary skill in the art because these materials are alternative and art recognized equivalent materials for forming the light emitting device having a compound semiconductor layer having an appropriate band gap energy.

5. Claims 2,6-12 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chen (Article of Pit formation in GaInN quantum wells, 9 February 1998) in view of Watanabe et al (6,555,846), as applied to claims 1,4,5,13-17,34 above, taken with Applicant's admitted prior art (present specification page 1-3).

Chen and Watanabe teach a method for forming a light-emitting device as applied to claims 1,4-5,13-17,34 above. Re claim 12, wherein the substrate includes sapphire (Fig 1).

Re claim 2, Chen teaches forming a light emitting device (LED), but lacks detailing about forming a first coating layer and second coating layer as in claim 2. Re claims 7-8, the first and second coating layer including $Ga_uAl_{1-u}N$. Re claim 9, MOCVD for depositing the coating layers. Re claim 10, including a buffer layer on the substrate. Re claim 11, the buffer layer include $Ga_mAl_{1-m}N$.

However, re claim 2, Applicant's admitted prior art teaches (at specification page 2, line 6 through page 3) forming a first coating layer formed from a compound semiconductor based on gallium nitride of a first conductivity type on the substrate; forming the compound semiconductor layer, as a light-emitting layer, over the first coating layer; and forming a second

coating layer formed from a compound semiconductor based on gallium nitride of a second conductivity type over the light-emitting layer, a composition of the compound semiconductor layer based on gallium nitride differing from a composition of the compound semiconductor of the first and second coating layers (present specification page 2, lines 6-26); wherein, re claims 7-8, the first and second coating layer include AlGaN layer (present specification page 2, lines 20-25); wherein, re claim 9, MOCVD is used for depositing the coating layers; and wherein, re claims 10-11, a buffer layer of GaN (m=1) is formed on the substrate, and wherein the first coating layer is formed on the buffer layer (present specification page 2, lines 20-25).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to form the light emitting device of Chen by forming a first coating layer and a second coating layers of AlGaN layer with a buffer layer on the substrate as taught by Applicant's admitted prior art. This is because of the desirability to form a high power structure blue and violet light emitting diode device.

Re claim 6, Chen apparently does not detail about doping with foreign substance.

However, Applicants' admitted prior art also teaches (at present specification page 3, lines 22-25) doping the light-emitting layer with a p-type foreign substance and/or an n-type foreign substance to improve the luminance.

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to the light emitting device of Chen by doping the light-emitting layer with a p-type foreign substance and/or an n-type foreign substance as taught by Applicant's admitted prior art. This is because of the desirability to improve the luminance of the light emitting device.

Response to Amendment

6. Applicant's remarks filed August 22, 2007 with respect to claims 1-2,4-17,34 have been considered but are moot in view of the new ground(s) of rejection.

** Applicant remarked (at remark pages 8-10) that "...Kawaguchi fails to teach...regions with the lower thickness are formed to be less than half as thick as the remaining portions of the compound semiconductor layer..." "...Since the difference between the top of a pyramid and the valley of a pyramid is 300 nm, the thickness of the $In_xGa_{1-x}N$ layer of Kawaguchi in the regions

of lower thickness is the difference between 2000nm and 300nm, i.e. 1700nm, which is significantly more than half as thick as the remaining regions of the semiconductor layer (i.e., 1700/2000nm = 0.85)".

In response, this is noted and found unconvincing. First, claimed subject matter, not the specification, is the measure of invention. Limitations in the specification cannot be read into the claims for the purpose of avoiding the prior art. In Re Self, 213 USPQ 1,5 (CCPA 1982); In Re Priest, 199 USPQ 11,15 (CCPA 1978). Second, the value of "1700/2000nm = 0.85" is calculated from the embodiment having a thick InGaN layer having a thickness of 2 micron.

However, as described above, in forming a thin InGaN layer, Kawaguchi also teaches (at Figs 4a,2b,1a; pages 25-28) growing an InGaN layer of about 0.1μm (100nm) in thickness, at the initial growth stage, wherein the InGaN initial layer includes a plurality of hexagonal small pits with the depth of about 30nm on average (thus, regions at bottom of the pits having a fixed thickness of about 100nm - 30nm = 70 nm). By further increasing the layer thickness, the area of facet in the pits becomes larger, wherein the thickness of the initial InGaN layer is increased by growing on the horizontal top surface of the initial InGaN layer (as shown in Figure 4a,2b) so that larger hexagonal pits are formed in the InGaN layer as shown in Figures 2c and 4b, wherein about "0.5μm up to the top of the pyramid" is mentioned at last two lines of page 26 (the regions at bottom of the pits still remained having the same thickness of about 100nm - 30nm = 70 nm). As shown in Figure 4a, the initial regions of the InGaN layer at the pits are about a half as thick as the remaining regions of the thin compound semiconductor layer of InGaN layer at region (I). By increasing the thickness of the InGaN layer at the same region (I), by growing on the horizontal top surfaces, the initial regions InGaN layer at region (I) are formed with the lower thickness to be less than half as thick as the remaining regions of the thin compound semiconductor layer of InGaN layer at region (I), wherein the initial regions at bottom of the pits are still remained with about the same initial thickness.

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Any inquiry concerning this communication or earlier communications from the examiner should be directed to Michael M. Trinh whose telephone number is (571) 272-1847. The examiner can normally be reached on M-F: 9:00 Am to 5:30 Pm..

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Zandra Smith can be reached on (571) 272-2429. The central fax phone number is (703) 872-9306.

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Oacs-18

Michael Trinh
Primary Examiner